Shetland Inshore Fish Survey (SIFS) 2024

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summary of catch rates, size compositions, and spatial distributions of commercial demersal fish species

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Shetland Inshore Fish Survey (SIFS) 2024: summary of catch rates, size compositions, and spatial distributions of commercial demersal fish species

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Executive summary

An overview of results from the Shetland Inshore Fish Survey (SIFS) conducted by UHI Shetland (formerly NAFC Marine Centre) from 2011 - 2024 in the coastal waters around Shetland is presented. The purpose of the survey is to provide independent information on the distribution, relative abundance, and population structure of fish species in local waters. Key results from the available data are reported here with a focus on commercially important species. This report is intended for a general audience with information presented in a concise and non-technical format.

The survey has been carried out annually using the 12 m MFV *Atlantia II* (LK 502) during August and September, using a standardised survey trawl fitted with a small-mesh (20 mm) cod-end. The original annual inshore fish survey involves hauls from 27 pre-defined locations within 12 nautical miles of Shetland. Since 2017, a concurrent shallow-water fish survey has been added, with up to 25 hauls targeting potential nursery grounds around the coast of Shetland. Catch rate results are used to investigate the relative abundance of commercial species by considering catch per unit effort (CPUE). Length data are used to further interpret variations in population structure and recruitment.

Results are presented with a focus on the most significant commercially important demersal fish species sampled throughout the surveys. Key findings from the 2024 surveys include:

- Haddock (*Melanogrammus aeglefinus*) continues to be the main component of catches, with the 2024 haddock data characterised by young age-classes that have not yet reached marketable sizes and been recruited into the fishery.
- Average catch rates for several key commercial species were at the lower end of observed values, e.g. haddock, cod (*Gadus morhua*), whiting (*Merlangius merlangus*) and plaice (*Pleuronectes platessa*), while other species of less commercial significance were particularly widespread and/or abundant this year, e.g. spurdog (*Squalus acanthias*), horse mackerel (*Trachurus trachurus*), and John Dory (*Zeus faber*).
- Squid (*Lologi* spp.) catch rate on shallow grounds in 2024 remain high following the record levels observed in 2023 and were concentrated in specific nearshore areas.
- Two fish species were recorded in small numbers during the survey this year for the first time, scaldfish (*Arnoglossus laterna*) and imperial scaldfish (*Arnoglossus imperialis*), both small flatfish species typically distributed further south.
- The data from shallow hauls suggests that some nearshore grounds around the coastline of Shetland are nursery areas for a variety of commercial species including plaice, haddock, whiting, and cod; and contain important commercially exploitable abundances of other species such as thornback ray (*Raja clavata*).

Final points of this report include a description of related ongoing work and the recommendation that the annual inshore and shallow fish surveys are continued.

1 Introduction

The provision of accurate data for analyses makes effective field sampling essential for understanding marine environments. The management of demersal fisheries resources requires data on the distribution and relative abundance of the fish species present on, or just above, the seabed. Understanding the population ecology of target species also requires further biological information.

Data from commercial fisheries are key components of stock assessments for many locally important stocks. However, the behaviour of individual fishing vessels targeting specific species and using different gear configurations can bias commercial data. Such effects must be considered when interpreting fisheries-dependent data. Therefore, independent data from scientific fisheries surveys are an important additional source of information, and annual surveys can be used to build valuable timeseries for investigating the dynamics of fish communities and for informing the management of fish stocks.

The International Bottom Trawl Survey Working Group (IBTSWG) coordinates international survey programmes for the International Council for the Exploration of the Sea (ICES). These programmes include annual fisheries-independent surveys in the North Sea and Northeast Atlantic which use several large research vessels from multiple countries to collect data over wide geographical areas. However, the spatial resolution of these surveys is limited by the large areas that require to be covered and as a result usually only two 30-minute hauls are undertaken in each approximately 30 x 30 nautical mile statistical rectangle. Such surveys often do not sample in inshore areas that are important areas for commercial fish species. Consequently, a smaller-scale survey using a vessel capable of sampling nearshore areas, such as is carried out in the Shetland Inshore Fish Survey, is beneficial for monitoring local temporal and spatial trends.

An annual fish survey has been undertaken in the waters around Shetland by the NAFC Marine Centre and now UHI Shetland since 2011. This survey was originally initiated in response to fishermen reporting high abundances of small cod on inshore fishing grounds (inside 12 nautical miles and approximately 50 - 150 m depth). Standardised scientific trawling gear and fishing methods have been used to provide an independent index of the nearshore distribution and relative abundance of demersal fish species. By repeating the survey each year, the resulting data have become increasingly valuable for determining the inter-annual variability of nearshore fish catch rates. Since 2017, these data have been further enhanced by an extended survey design which targets potential nursery grounds in shallow areas (approximately 20 - 50 m) to collect additional information on juvenile fish (smaller and younger fish yet to reach sexual maturity).

The catch from each haul provides information on which species are present at that location and in what quantities, as well as the size compositions of key species. Size information is used to infer population structure and to indicate the strength of particular year-classes (those fish born in any one year) which can reveal variations in recruitment (the number of fish surviving to enter the commercial fishery). Young individuals yet to be recruited to the commercial fishery are captured using scientific trawl gear which has smaller mesh sizes in the cod-end. Consequently, scientific trawl data provide important information on juvenile abundances which are not available from commercial landings due to the restrictions on landing sizes and gear design.

The use of standardised survey methods is essential to ensure that any changes in catches over time accurately reflects variability in the composition of demersal fish communities. The efficiency of trawling gear at catching fish is species-dependent, and so trawl surveys typically provide relative estimates rather than information on absolute abundances. Multiple hauls across a range of areas enables more robust estimates to be made and the variability of results to be quantified.

This report provides an overview of key results from the available survey data collected from 2011 to 2024. The focus of this report is on information for marketable demersal species which are most significant to the local mixed whitefish fishery. Results are presented in a concise and non-technical format aimed at being accessible to all those involved in fisheries and the general public. The purpose of this report is to: (1) provide an up-to-date and independent source of information on the present relative abundance and recruitment of commercially important fish species in the nearshore waters around Shetland; and (2) to contextualise these results within the inter-annual trends in catch rate and size composition from the previous 13 continuous years of survey data.

2 Materials and methods

2.1 Survey design

The Shetland Inshore Fish Survey (SIFS) has been carried out each year since 2011 during August and September around the coast of Shetland up to 12 nautical miles from shore. Initially the survey was designed to target known fishing grounds over a range of depths (approximately 50 – 150 m). In the first year, the locations of 21 survey tows were defined. In subsequent years, a further six tows were added giving 27 set inshore locations (Figure 1). In 2017, a shallow-water fish survey targeting potential nursery areas was added, sampled concurrently to the original inshore fish survey, and has been undertaken annually since. The 25 additional shallow water tows were chosen to follow a similar coverage around Shetland as the existing inshore survey but to extend coverage onto comparatively shallow grounds of approximately 20 – 50 m (Figure 1). Tow duration is variable in the shallow tows, ranging from approximately 0.22 – 0.65 hr (average is 0.43 hr), due to the limited suitable ground available in most shallow areas. Surveys were carried out under a derogation granted by Marine Scotland and with survey hauls in protected areas approved following input from NatureScot.

2.2 Trawl data

Survey work was conducted by UHI Shetland staff aboard the 12 m MFV *Atlantia II* (LK 502). The survey gear was based on a standard four-panel box trawl fitted with a small-mesh (20 mm) inner net (Figure 2). In 2024, a new survey trawl was used which was constructed by UHI Shetland earlier in the year and was an exact copy of the original gear used in previous years, some components of which were nearing the end of their useful life span. Details on the design of the net and rigging of the gear are presented in Figure 2 and Figure 3. Door spread and trawl headline height were monitored using a Notus net monitoring system. Prior to undertaking survey trawls, the performance of the new gear was first assessed using underwater video cameras and the net monitoring system to confirm that the performance matched the characteristics of the original gear.

The gear was towed at approximately 2.5 knots with tow duration defined by the time from when the doors and net were open on the seabed until when the trawl winch was engaged to haul the gear. At each location, a towing duration of 1 hr was used whenever operationally possible. The presence of static fishing gear and other obstructions resulted in some minor variation in the locations and durations of survey tows from year to year.

The catch from each haul was first sorted by species then weighed. For commercially important fish species the individual total lengths were measured. Length data were also collected for selected non-commercial elasmobranchs (i.e. sharks and skates) including flapper skate (*Dipturus intermedius*) which will be presented elsewhere (SMEEF project 502255-2023). Only total weight data were recorded for squid (*Loligo* spp.) and other selected cephalopods (i.e. other squid and cuttlefish species). Subsampling for length measurements was necessary in some hauls for species caught in particularly high abundances, in which case a random subsample was taken and its weight recorded. Hauls which were potentially affected by damage to the gear or operational problems were invalidated and excluded from analysis. Invalidated hauls were repeated when possible.

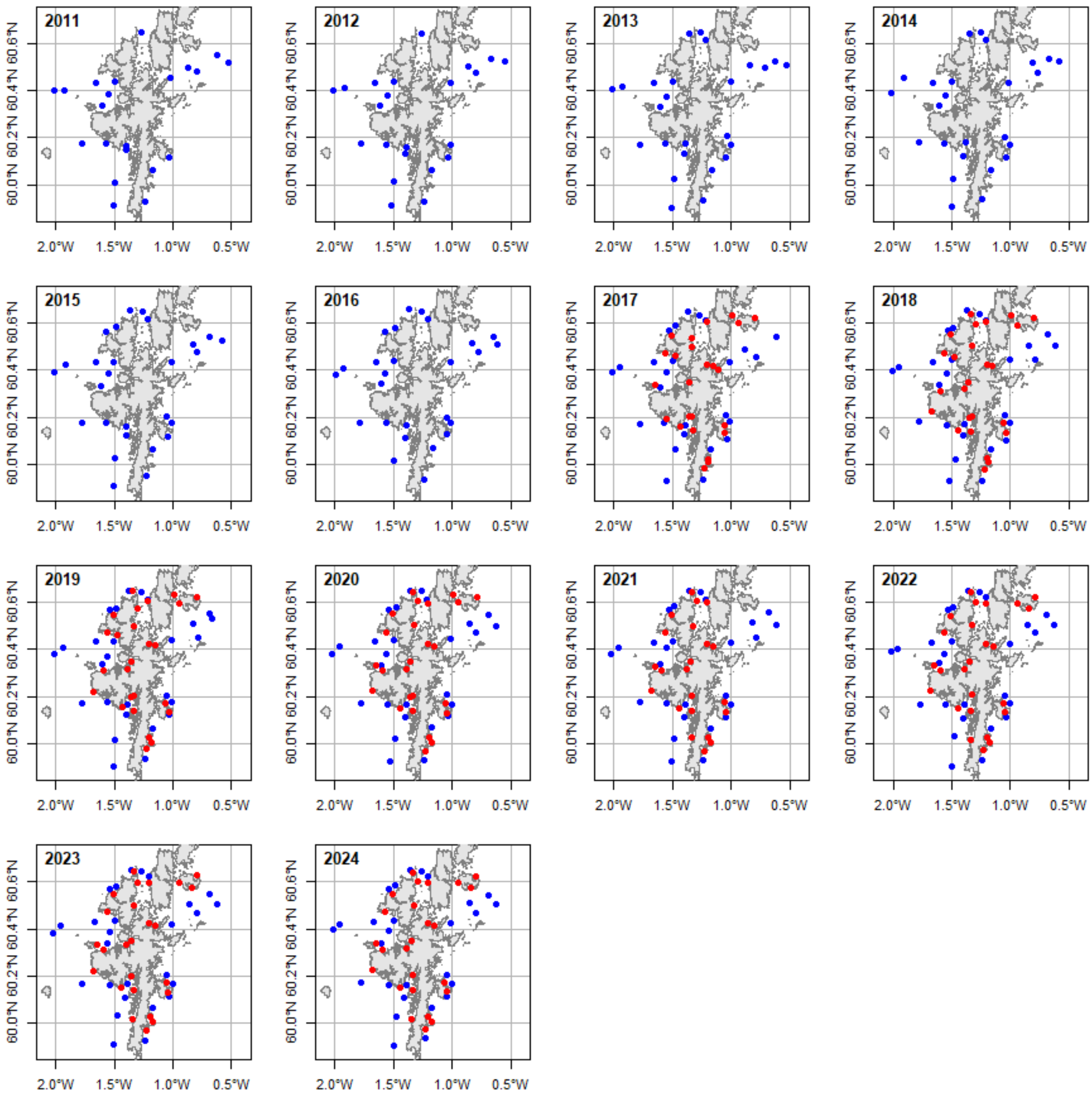

Figure 1. The locations of inshore (blue) and shallow (red) haul locations shown by year. Each location shows the approximate mid-point of each valid haul.

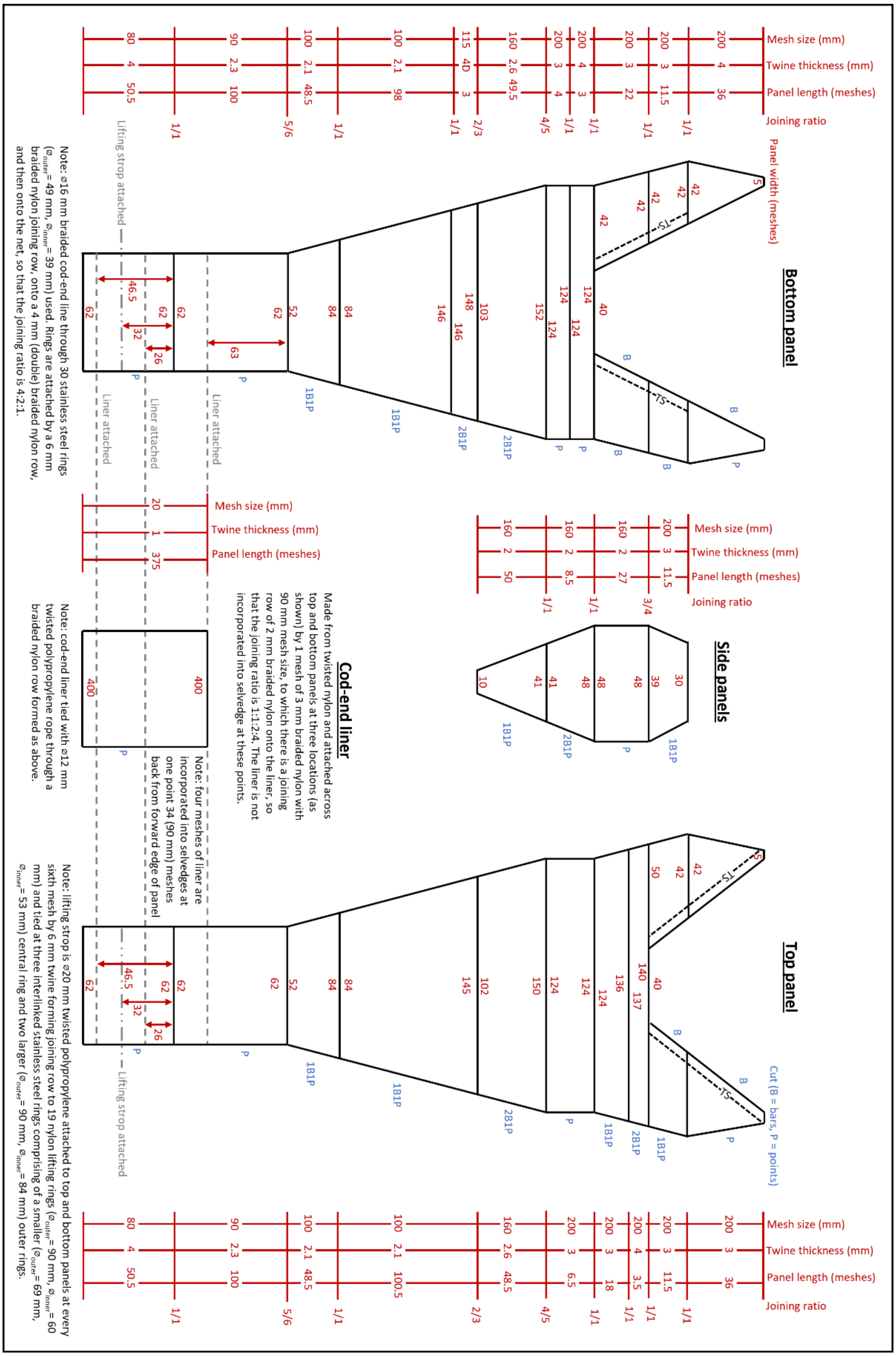

Figure 2. Net plan for the UHI Shetland inshore fish survey trawl. Mesh sizes are knot centre to knot centre measurements. Panel length does not include half-mesh joining rows. Panel widths include selvedge meshes (typically 5 per side). Chaffer panel attached 2.5 meshes aft of lifting strop attachment point and made from 180 mm mesh size, 6 mm twine, 8 meshes deep, 28 meshes wide, fastened to net on every second mesh of bottom panel. Cut details marked in blue are approximate only. “D” refers to double mesh. “TS” refers to tear strip which is included in panel width measurements and made from 5 meshes of 4 mm twine and 200 mm mesh size. Twine is braided polyethylene unless otherwise stated. Netting is knotted diamond mesh unless otherwise stated.

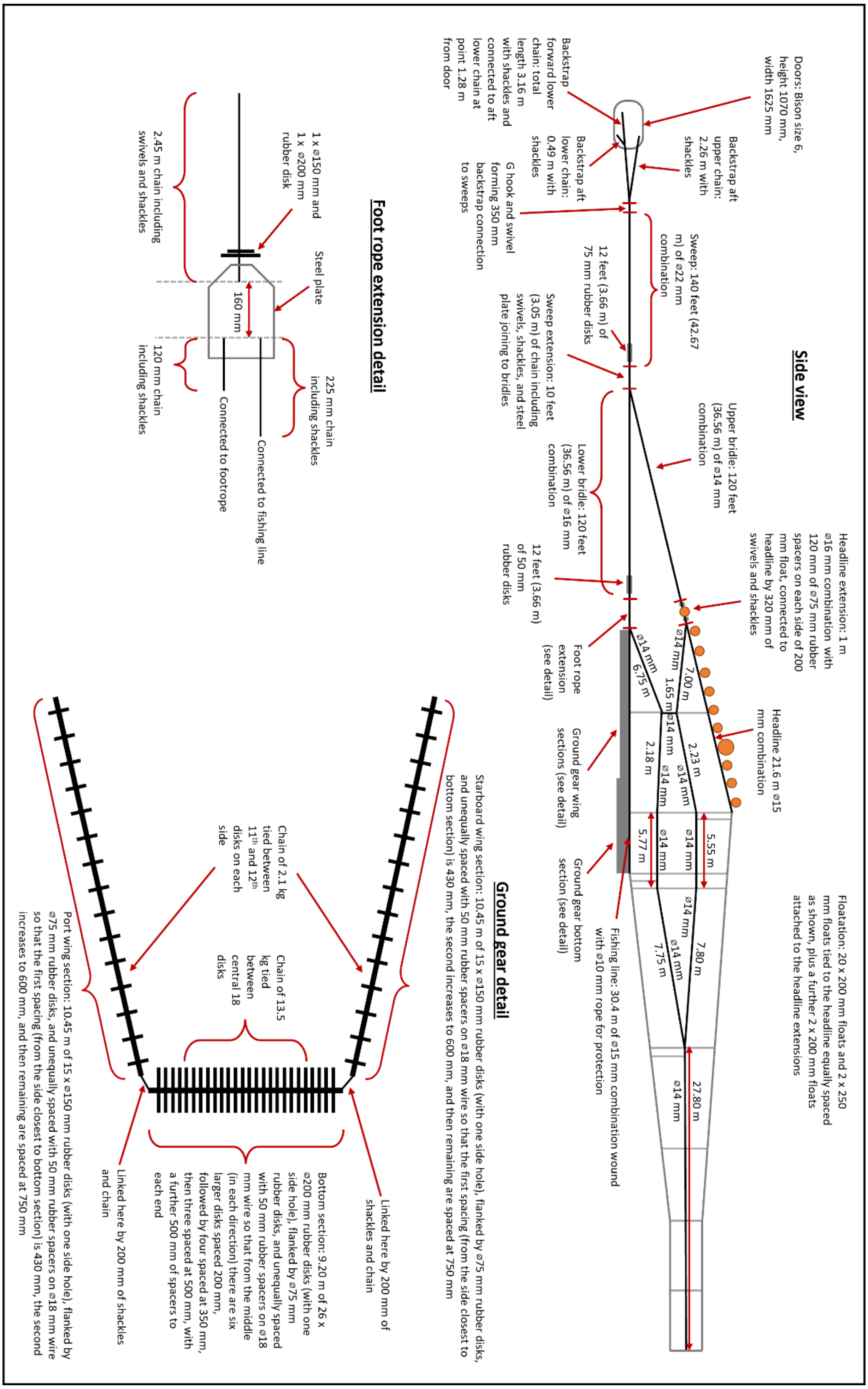

Figure 3. Rigging details for the UHI Shetland inshore fish survey trawl. Length measurements are given as outside eye to outside eye. Ropes are twisted polypropylene unless otherwise stated.

2.3 Data analysis and interpretation

Data from the inshore and shallow components of the survey are initially combined to provide an overview of recorded species during the 2024 survey and an indication of species prevalence (i.e. the percentage of survey hauls that a specific species was present in). Elsewhere, data are shown separately for the inshore and shallow elements of the survey due to both the difference in timeseries length of the data (since 2017 for the shallow hauls) and due to the general differences in catch composition from shallow hauls compared to those from the inshore hauls. The main analyses are restricted here to the most commercially important demersal fish species present throughout the surveys:

- Haddock (*Melanogrammus aeglefinus*)
- Plaice (*Pleuronectes platessa*)
- Whiting (*Merlangius merlangus*)
- Cod (*Gadus morhua*)
- Monkfish (*Lophius* spp.)
- Lemon sole (*Microstomus kitt*)
- Thornback ray (*Raja clavata*)
- Cuckoo ray (*Raja naevus*)
- Spotted ray (*Raja montagui*)
- Saithe (*Pollachius virens*)
- Megrim (*Lepidorhombus whiffiagonis*)
- Witch (*Glyptocephalus cynoglossus*)
- Ling (*Molva molva*)
- Turbot (*Scophthalamus maximus*)
- Hake (*Merluccius merluccius*)
- Squid (*Loligo* spp.) (weights only)

In order to provide an index of relative abundance for each species the catch rates were calculated. Catch rate is expressed as the catch per unit effort (CPUE). While catch is generally quantified in terms of weight, this approach is less sensitive to hauls with high numbers of small fish which may be of interest when considering future recruitment to the fishery. Consequently, CPUE was considered both in terms of weight (kg / hr) and by number of individual fish (number / hr). Only weight data were recorded for squid. The average CPUE was calculated across all hauls in each year, and the variability between hauls was quantified by the standard error of the mean.

The size compositions of catches were investigated by considering length frequency distributions. For the above fish species, the total number (count) of individuals in each 1 cm length class was calculated for each haul and corrected for sub-sampling when necessary, then summed over each year. Note that for simplicity of display these count data are not standardised to survey effort here. Peaks in length frequency distributions can indicate the growth and survival of specific year-classes, the age of which was inferred by using established age-length relationships for the species.

Spatial distribution results for this year are also presented for selected species to provide some basic insights into how catches varied by haul across the study area. For the purposes of making general observation on the spatial patterns of commercial species including squid, the catch rate by weight is considered.

3 Results

3.1 Data overview

An overview of the 2024 Shetland Inshore Fish Survey catch data is presented in Table 1 which includes all recorded species. Commercial catches during this survey were principally haddock, plaice, and cod; followed by monkfish, lemon sole, and whiting. Skate species also formed a substantial portion of catches, in particular thornback ray, cuckoo ray, and spotted ray. Other commercial demersal species formed a relatively small component of overall catches.

Non-commercial species accounted for approximately 40% of the overall catch by weight and were comprised primarily of lesser spotted dogfish (*Scyliorhinus canicular*), common dab (*Limanda limand*a), flapper skate (*Dipturus intermedius*), grey gurnard (*Eutrigla gurnardus*), Norway pout (*Trisopterus esmarkii*), and lesser Argentine (*Argentina sphyraena*). Common dab was the most prevalent species during the 2024 survey and was recorded in all survey hauls. The next most prevalent species were grey gurnard (96%), plaice (92%), and cod (88%).

Although of limited commercial importance, spurdog (*Squalus acanthias*) catches during 2024 were noticeably more than in previous years, and when considered in terms of CPUE the combined spurdog catch for inshore and shallow was 5.90 kg / hr, many times higher than the next highest combined spurdog catch year which was in 2022 at 0.89 kg / hr. Further, spurdog were more prevalent than in previous years, occurring over 19% of survey areas in 2024 compared to an average of 4% over the preceding five years.

Similarly, horse mackerel (*Trachurus trachurus*) catches were noticeably higher with combined catch results corresponding to an overall catch rate of 2.85 kg / hr in 2024, the highest yet recorded and compared to a combined average of 0.92 kg / hr over previous years.

John Dory (*Zeus faber*) were substantially more prevalent in 2024 than in recent years, and were recorded in 42% of survey hauls this year which compared to an average of 11% during the preceding five years. Similarly, ling, turbot, and boarfish (*Capros aper*) were more also markedly more prevalent this year compared to preceding years (29% compared to 13% for ling, 17% compared to 7% for turbot, and 25% compared to 9% for boarfish).

Unusually, there was records of species caught this year that had never been observed previously across the entire SIFS dataset, specifically scaldfish (*Arnoglossus laterna*) and imperial scaldfish (*Arnoglossus imperialis*), both observed in small numbers from sperate tows in the St Magnus Bay area. These are both small flatfish species typically distributed further south, in the case of *A. laterna* there are some limited previous records from the Northern Isles while available information for *A. imperialis* suggests the nearest previous observations are limited to the coast of Ireland and southern Scotland.

Table 1. Summary of fish species and selected cephalopods recorded during SIFS 2024. These results combine data from both the inshore and shallow elements of the survey. *Indicates species that were subsampled.

Species	Scientific name	Total weight (kg)	Total measured	Prevalence
Haddock	*Melanogrammus aeglefinus*	854.22	3386*	87%
Plaice	*Pleuronectes platessa*	767.17	1942	92%
Less spotted dogfish	*Scyliorhinus canicula*	501.60	663	87%
Common dab	*Limanda limanda*	403.83	---	100%
Flapper skate	*Dipturus intermedius*	368.56	37	27%
Cod	*Gadus morhua*	298.43	489	88%
Grey gurnard	*Eutrigla gurnardus*	258.41	---	96%
Monkfish	*Lophius* spp.	223.93	142	67%
Lemon sole	*Microstomus kitt*	206.40	1090	77%
Whiting	*Merlangius merlangus*	195.51	1210	69%
Norway pout	*Trisopterus esmarkii*	190.97	---	37%
Thornback ray	*Raja clavata*	185.81	110	52%
Lesser argentine	*Argentina sphyraena*	184.57	---	54%
Squid	*Loligo* spp.	179.17	---	85%
Spurdog	*Squalus acanthias*	138.49	99	19%
Cuckoo ray	*Raja naevus*	120.27	109	58%
Spotted ray	*Raja montagui*	114.58	65	21%
Poor cod	*Trisopterus minutus*	107.79	---	60%
Horse mackerel	*Trachurus trachurus*	77.22	---	38%
Red gurnard	*Chelidonichthys cuculus*	77.05	---	73%
Turbot	*Scophthalamus maximus*	30.54	13	17%
Long rough dab	*Hipploglossoides platessoides*	27.39	---	37%
Ling	*Molva molva*	19.81	29	29%
Megrim	*Lepidorhombus whiffiagonis*	18.26	55	25%
Hake	*Merluccius merluccius*	13.31	17	13%
Mackerel	*Scomber scombrus*	12.75	---	23%
Saithe	*Pollachius virens*	11.24	24	25%
Herring	*Clupea harengus*	9.95	---	21%
Witch	*Glyptocephalus cynoglossus*	9.44	36	15%
Conger eel	*Conger conger*	8.67	1	2%
John Dory	*Zeus faber*	5.63	43	42%
Smooth sandeel	*Gymnammodytes semisquamatus*	5.55	167*	25%
Great sandeel	*Hyperoplus lanceolatus*	4.52	29	17%
Boarfish	*Capros aper*	2.86	---	25%
Shagreen ray	*Leucoraja fullonica*	2.52	1	2%
Blue whiting	*Micromesistius poutassou*	2.32	---	6%
Nephrops	*Nephrops norvegicus*	1.68	---	4%
Bluemouth	*Helicolenus dactylotperus*	1.44	---	12%
Raitt's sandeel	*Ammodytes marinus*	1.44	46*	12%
Brill	*Scophthalamus rhombus*	1.38	1	2%
Common dragonet	*Callionymus lyra*	1.17	---	19%
Halibut	*Hippoglossus hippoglossus*	1.04	1	2%
Silvery pout	*Gadiculus thori*	0.59	---	6%
Flounder	*Platichthys flesus*	0.42	---	2%
Pogge	*Agonus cataphractus*	0.30	---	12%
Shortfin squid	*Illex* spp.	0.25	---	4%
Norway haddock	*Sebastes viviparus*	0.25	1	2%
Scorpion fish	*Myoxocephalus* spp.	0.15	---	6%
Greater forkbeard	*Phycis blennoides*	0.14	2	2%
Sprat	*Sprattus sprattus*	0.09	---	4%
Solenette	*Buglossidium luteum*	0.06	---	4%
Topknot	*Zeugopterus punctatus*	0.06	---	6%
Bobtail squid	*Sepiolidae* spp.	0.05	---	4%
Butterfish	*Pholis gunnellus*	0.04	---	4%
Goby	*Gobididae* spp.	0.04	---	6%
Cuttlefish	*Sepiidae* spp.	0.04	---	2%
Imperial scaldfish	*Arnoglossus imperialis*	0.02	---	2%
Snake blenny	*Lumpenus lampretaeformis*	0.02	---	2%
Scaldfish	*Arnoglossus laterna*	0.01	---	2%

3.2 Catch rates by weight and number

CPUE results by weight are presented in Figure 4 and are arranged by species in order of overall contribution by weight to the 2024 survey catch data. CPUE results for the inshore and shallow survey hauls are calculated separated in the following analyses. Results from both the inshore and shallow survey elements are coloured and superimposed to aid comparisons. From some species, low abundances (for example turbot) or very high variability between hauls (for example saithe) limit the scope for meaningful analyses, but these results are included for completeness and to form a baseline of data for future studies.

For most species, catch rates (by weight) in the shallow hauls were less than those from the inshore hauls. Some species, such as witch, were regularly present in inshore hauls but were absent in the 2024 shallow hauls. In contrast, catch rates of plaice, thornback ray, squid, and spotted ray were markedly higher in the 2024 shallow hauls compared to the inshore hauls.

Haddock catches over the timeseries of the surveys have been variable, characterised by a cyclic pattern with peaks and troughs. Considered over the entire inshore timeseries, haddock catches in 2024 could be described as being in a trough following successively lower average catch rates since the record levels recorded in 2021. Haddock catches in shallow grounds in 2024 showed some evidence of an increase from the previous years and were at a level almost comparable to inshore catches.

Cod catch rates were highest in the earliest years of the surveys, 2011 – 2018, and inshore cod catches in 2024 are well below the overall inshore survey average. Results for mean cod catch rate were fairly similar between inshore and shallow hauls in 2024, following the relatively high cod catch rates observed in shallow waters during 2022.

Whiting catch rates on inshore hauls have been variable over the timeseries and the available data indicate a continued decrease since a peak in 2020. Whiting catch rates on shallow hauls could be described as average in 2024 are only slightly lower than whiting catch rate from inshore hauls.

The 2024 data for plaice suggest that inshore and shallow catch rates are slightly down from the low levels observed in the previous year. Over the timeseries, monkfish catch rates were higher between 2014 - 2018 than they are currently. Monkfish catch rates appear to be relatively stable in the inshore grounds over the last couple years while the shallow hauls show some evidence of a decrease since a period of stability between 2017 and 2021. Lemon sole catch rates from inshore hauls have generally been variable over the timeseries, but more similar catch rates have been recorded since 2021.

The mean catch rate for squid on shallow grounds in 2024 was almost as high as the record levels recorded in 2023 (10.83 kg / hr compared to 13.00 kg / hr), while inshore squid catches were similar to the more average levels recorded in 2023 which followed high catch rates in 2022.

Catches of cuckoo ray have generally shown a decreasing trend over the timeseries. Thornback ray catch rates have been relatively stable on inshore grounds over the timeseries, while those from shallow hauls are higher, but more variable. For spotted ray, catch rates for inshore hauls were higher in 2024 than the low levels recorded over the previous two years. While spotted ray catch rates from shallow water hauls are higher than from inshore hauls, the mean catch rate in shallow grounds in 2024 was less than the peak recorded in 2022, and approximately average.

Although only observed in small numbers, the 2024 data indicate a higher catch rate of ling on shallow grounds than previously recorded. Similarly, mean turbot catch rate on shallow grounds was the highest yet recorded at 1.91 kg / hr, more than twice the next highest year which was 0.94 kg / hr in 2020. Similarly, megrim catches on inshore grounds are at the highest level since 2016 and continue to indicate a steadily increasing trend since the low levels recorded in 2021.

For other species, catch rates in 2024 were often within the range and standard errors of results from previous years. Large standard errors indicate high variability between hauls, which was observed in species such as saithe and often coincided with years of higher average catch rates.

When considering catch results by weight the potential contribution of smaller fish in nursery grounds is more likely to be obscured, and so these results are investigated in more detail by considering CPUE results by number in Figure 5. The general patterns of these catch rates are similar to the results in Figure 4 in most cases, for example the skate and flatfish species. Where there is a divergence in trends between Figure 4 and Figure 5 it indicates a substantial change in the overall size composition of that species.

For most species, the 2024 catch rate by number (Figure 5) fluctuates within the range and standard errors of results from previous years. This is the case for haddock which was the most abundant commercial species observed this year. However, plaice and whiting catch rates (by number) are at low levels compared to previous years, particularly in inshore grounds. Results indicate that fewer numbers of monkfish were observed in 2024, which continues the trend observed in 2023 and a return to levels observed during early years of the inshore survey.

To understand how the size composition of species has varied in more detail, length frequency distributions are examined in the following section.

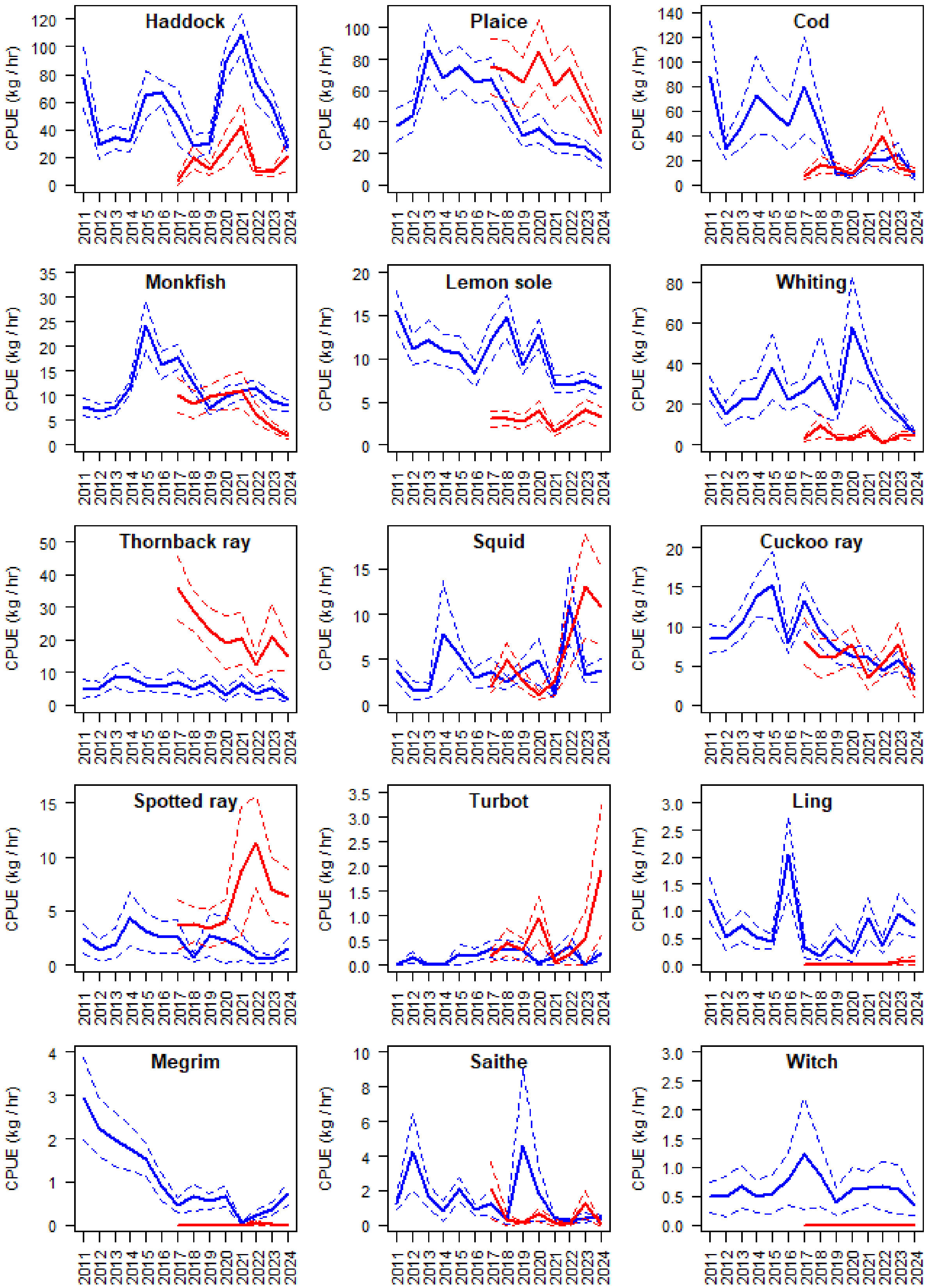

Figure 4. Catch per unit effort (CPUE) by weight for the inshore (blue) and shallow (red) elements of the fish survey. Presented species are selected and ordered by overall contribution to 2024 catches by weight. For each year of available data the mean result for all valid hauls is shown (solid lines) with the variability between hauls indicated by the standard error (dashed lines). **How to interpret: these results show how the average catch rates in weight (y-axis) have changed over time from 2011 to 2024 (x-axis) for each selected species.**

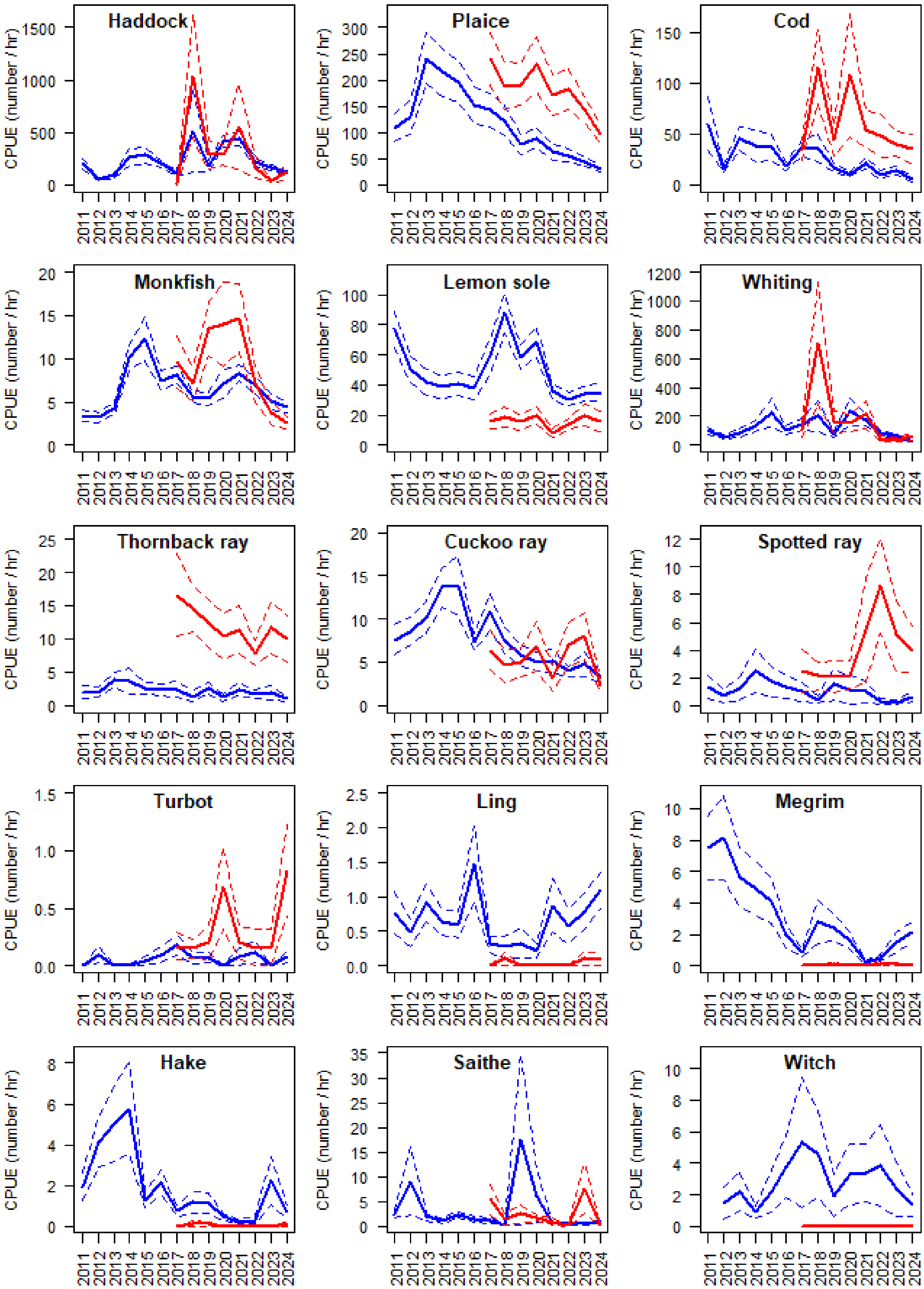

Figure 5. Catch per unit effort (CPUE) by number for the inshore (blue) and shallow (red) elements of the fish survey. For each year of available data, the mean result for all valid hauls is shown (solid lines) with the variability between hauls indicated by the standard error (dashed lines). Note that results for witch in 2011 are omitted due to unrecorded data. **How to interpret: these results show how the average catch rates in weight (y-axis) have changed over time from 2011 to 2024 (x-axis) for each selected species.**

3.3 Size compositions

The length frequency distributions for each year are presented in Figure 6 to Figure 10. These results are interpreted in relation to changes in the population structure of the selected species in the shallow and inshore survey areas. Note that for simplicity of display these count data have not been standardised to survey effort (CPUE) and consequently the reader should not use these figures for making comparisons between quantities of catches in different areas and years.

The size composition of haddock catches (Figure 6) in both the inshore and shallow hauls continues to indicate strongly intermittent patterns in recruitment. Strong haddock year-classes can be followed over successive years, such as in 2014 where the clear peak in small haddock centred at 13 cm (age-0) can be followed to 26 cm (age-1) in 2015 and then at 35 cm (age-2) in 2016. Inshore and shallow haddock catches in 2024 have a clearly defined central dominant peak at 24 cm, with marketable size classes less abundant and characterised by a barely detectable second peak centred at 35 cm. Although too few to see at the scale presented, there were also limited observations of age-0 haddock in both the inshore and shallow hauls this year centred at 10-13 cm.

Whiting length data (Figure 6) from inshore hauls in 2024 where characterised by age-0 fish in the range 9-11 cm and a separate broad dominant peak centred at 31 cm. While shallow whiting data were mostly dominated by age-0 fish in the range 8-10 cm and a smaller secondary peak centred at 23 cm.

In comparison to most other species, cod length distributions are more variable over the timeseries (Figure 6). Inshore cod catches in 2024 were characterised by a lack of structure over a broad range of 9 – 88 cm. Shallow haul results for cod in 2024 indicated the presence of well-defined age-0 population predominately in the range 8 – 10 cm.

Overall, for haddock, whiting, and cod, despite relatively low overall catch rates in 2024 there was more evidence of a strong age-0 year-class than in 2023 in all cases.

Plaice length distribution results continue to indicate a relatively stable size structure over time, this year peaking at approximately 32 cm in inshore hauls and 28 cm in shallow hauls (Figure 7). Plaice less than 20 cm were found only in shallow hauls in 2024.

The lemon sole data (Figure 7) also show a relatively stable size composition in recent years, with a single dome shaped distribution centred at approximately 23 cm in 2024 and little evidence of distinct year-classes.

The monkfish length data (Figure 5) indicate a variable pattern through time and the presence of outliers over a relatively wide length range. The few observations of monkfish on shallow grounds in 2024 are mostly in the range 28 – 34 cm while inshore catches are characterised by generally larger monkfish with a peak in the region of 45 cm.

Length data for cuckoo ray (Figure 8) in 2024 show an asymmetric distribution as in previous years, this year peaking in inshore hauls at 62 cm, with the smallest specimen so far recorded (14 cm) being caught this year in a shallow haul. Thornback ray in 2024 were recorded more symmetrically over a relatively wide length range (Figure 8) in both shallow and inshore surveys. Spotted ray length data for this year are mostly in the region 52 – 74 cm and indicate a wider length range observed in shallow hauls compared to inshore hauls (Figure 8).

Saithe length data (Figure 9) from inshore hauls were recorded over the range 25 – 50 cm in 2024 and showed little structure, while shallow data for saithe indicated a small number observed in much narrower range (27 – 30 cm). Megrim catches in 2024 were only observed in inshore hauls and spanned 20 – 56 cm with some evidence of a peak at 27 cm like in 2023 (Figure 9). As in previous years, ling were almost exclusively caught from the inshore tows and abundances too low to describe the population structure. However, in 2024 the smallest ling specimen yet recorded (15 cm) was observed in one of the inshore hauls (Figure 9).

Witch results from inshore hauls in 2024 show a similar length distribution to that recorded during the preceding three years (Figure 10). The length distribution of hake shows a much higher variability over recent years and spanned a much broader length range in 2024 (19 – 80 cm) than in 2023 with almost all observations in inshore hauls (Figure 10). The relatively high numbers of turbot observed in shallow grounds occurred over a broad length range with the largest turbot yet recorded throughout both the inshore and shallow datasets observed in 2024 at 74 cm from a shallow haul (Figure 10).

Spatial distribution results are presented in the next section to look in more detail at how catches varied between inshore and shallow hauls and across the survey area.

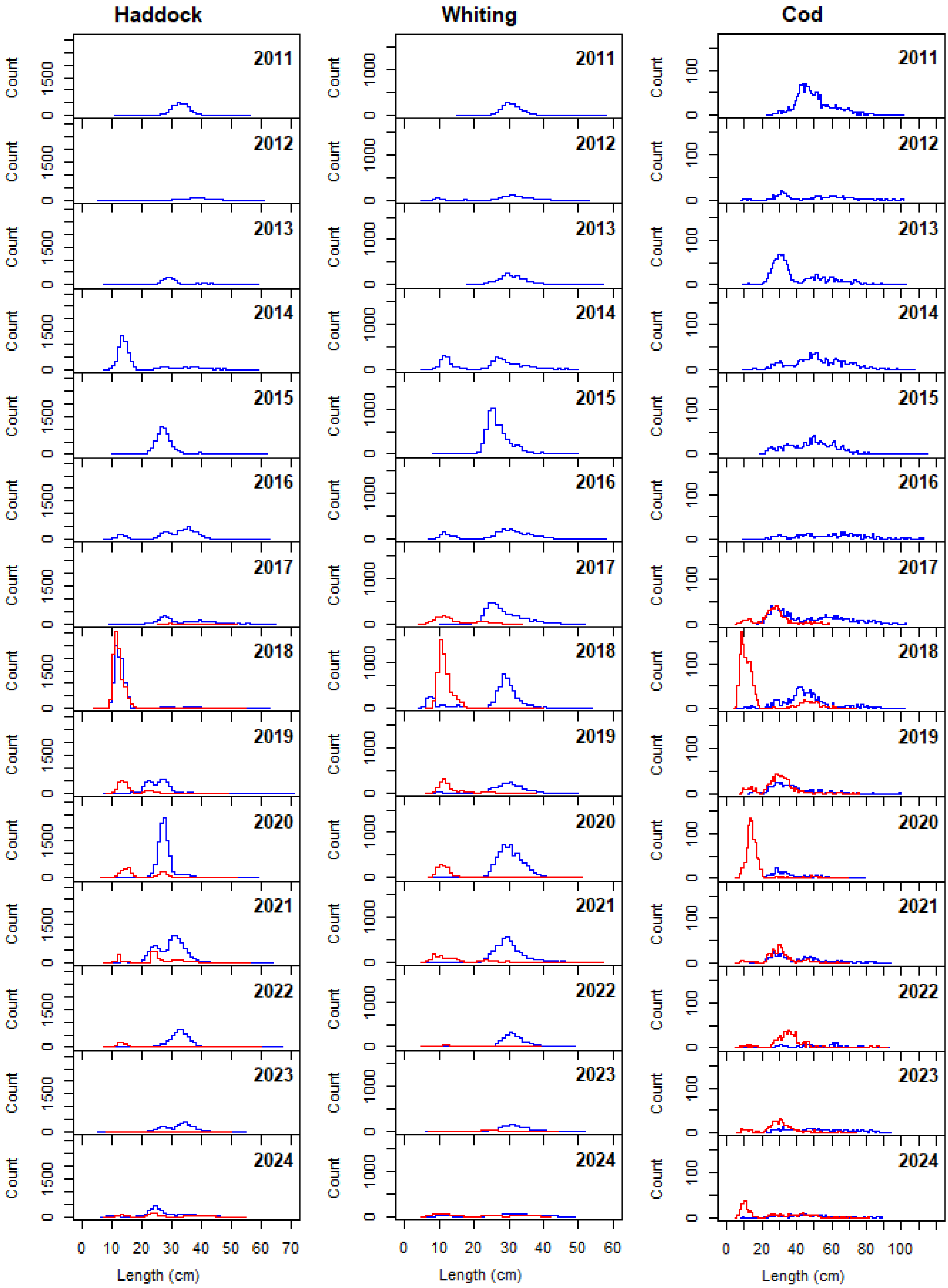

Figure 6. Length distribution results showing the total number (count) of individual fish in each 1 cm length class caught during the inshore (blue) and shallow (red) elements of the survey. **How to interpret: these results show the numbers of individual fish (y-axis) of each species in every 1 cm size category (x-axis) during each survey year. Note that these data are not standardised to survey effort.**

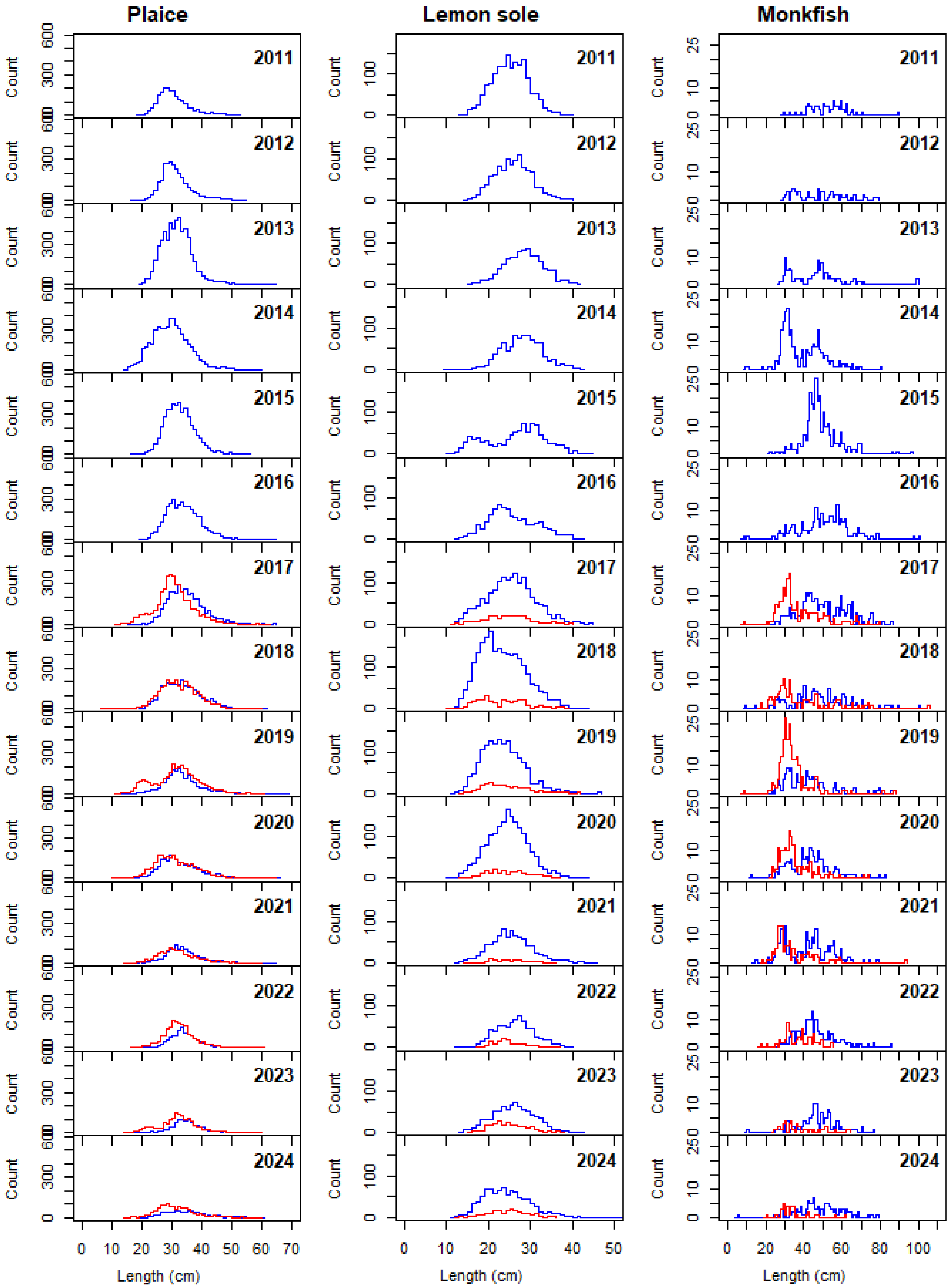

Figure 7. Length distribution results showing the total number (count) of individual fish in each 1 cm length class caught during the inshore (blue) and shallow (red) elements of the survey.

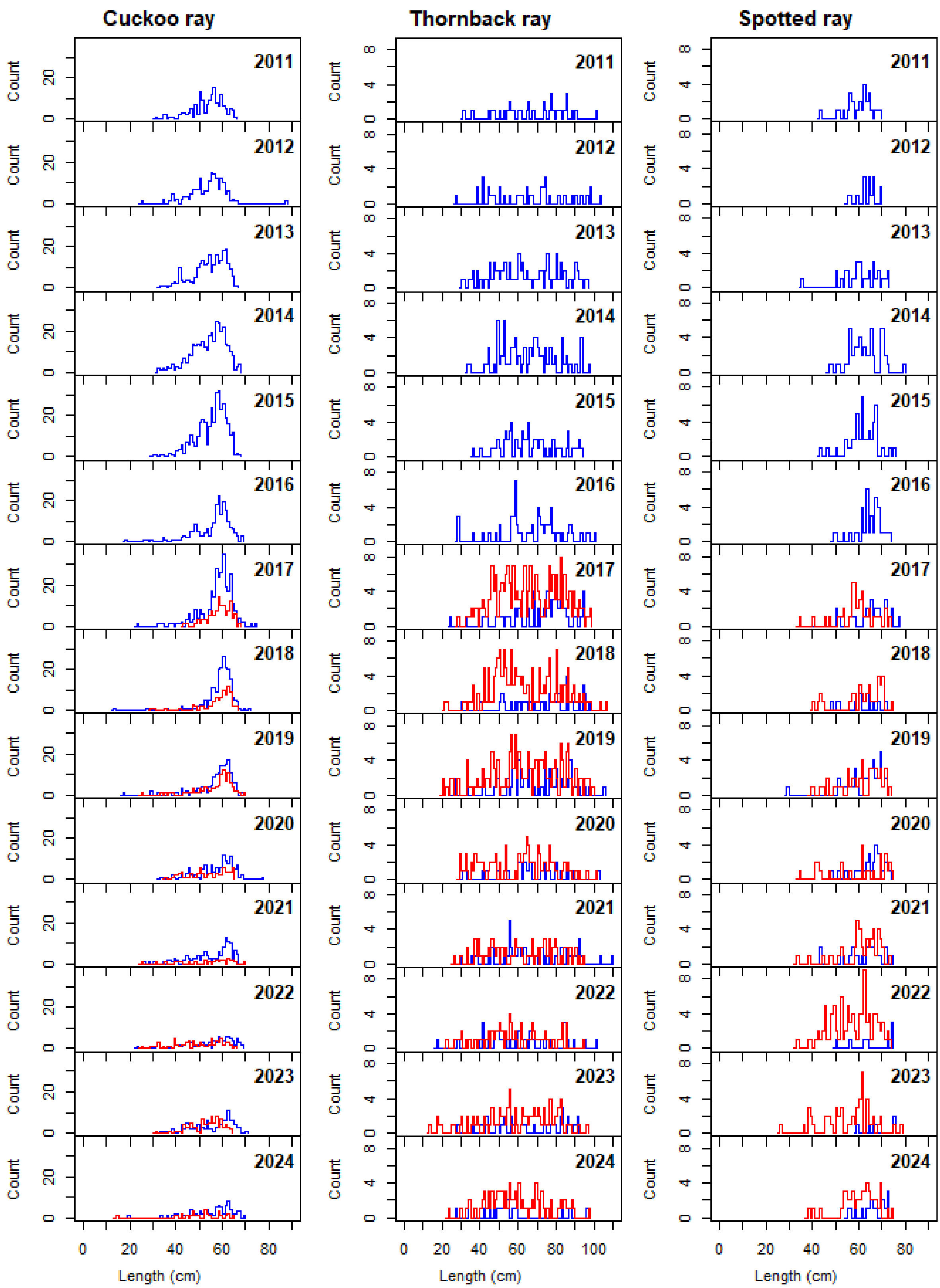

Figure 8. Length distribution results showing the total number (count) of individual fish in each 1 cm length class caught during the inshore (blue) and shallow (red) elements of the survey.

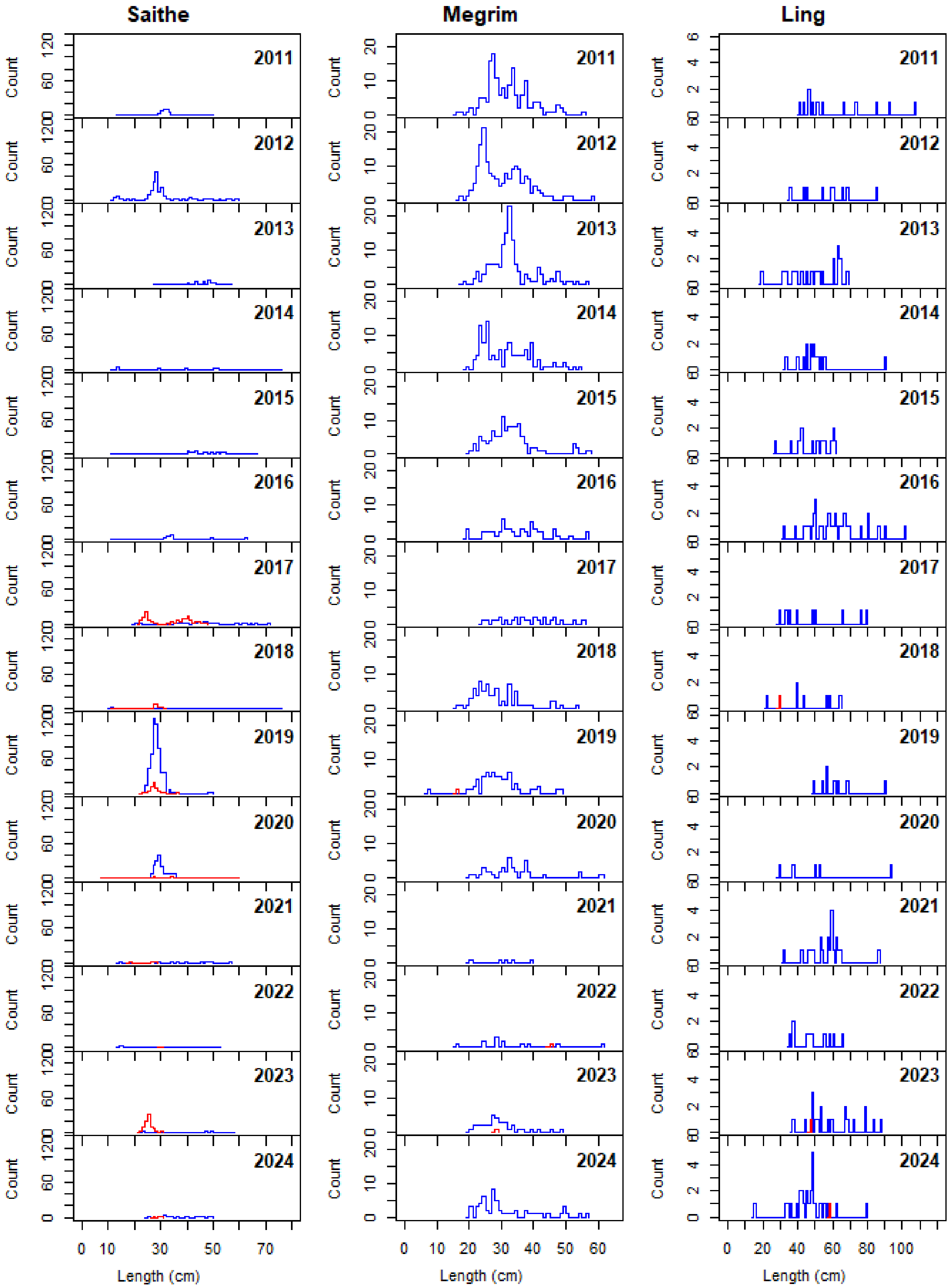

Figure 9. Length distribution results showing the total number (count) of individual fish in each 1 cm length class caught during the inshore (blue) and shallow (red) elements of the survey.

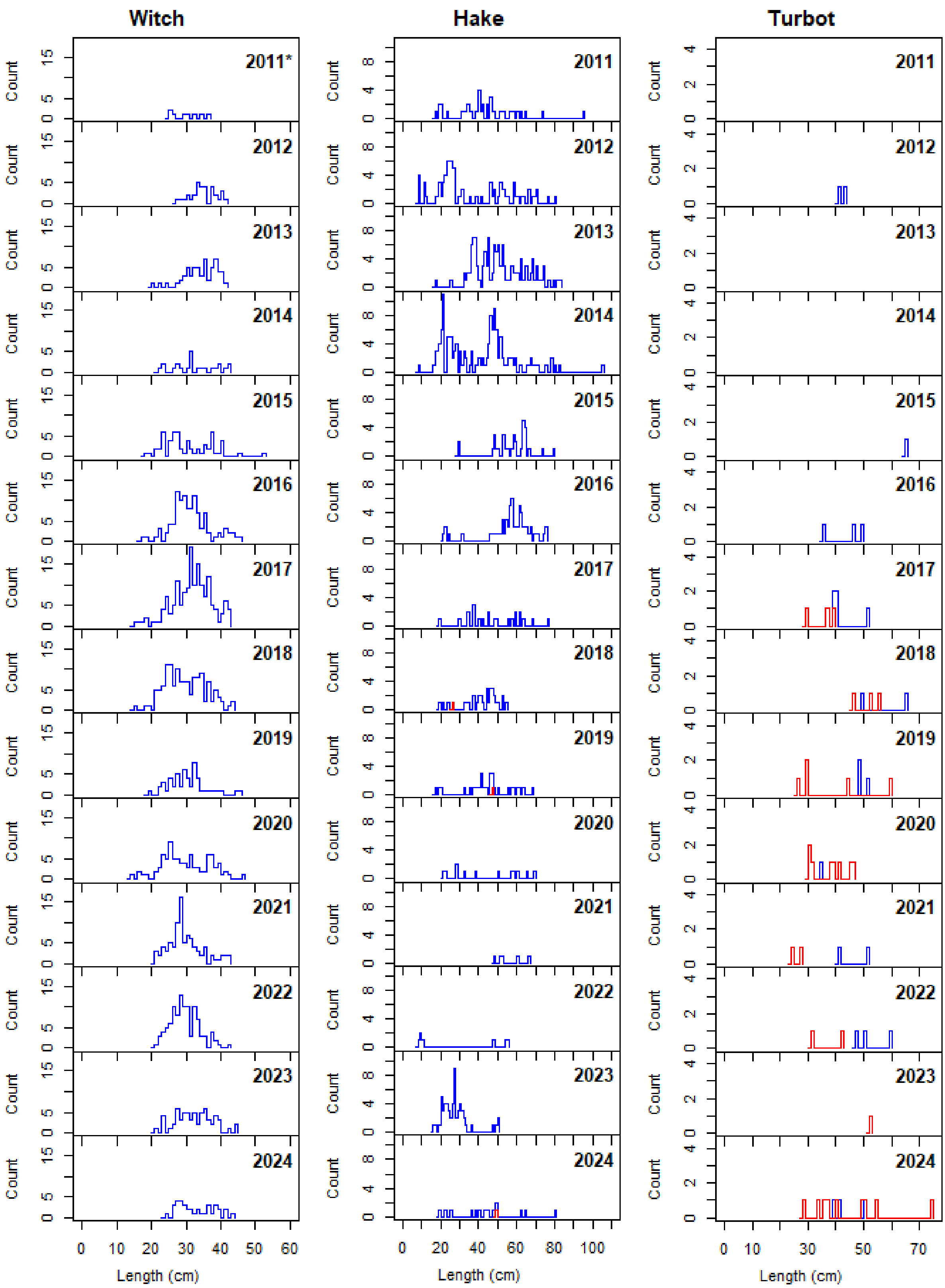

Figure 10. Length distribution results showing the total number (count) of individual fish in each 1 cm length class caught during the inshore (blue) and shallow (red) elements of the survey. *Note that length data for witch in 2011 were unrecorded for some hauls.

3.4 Spatial distributions

Spatial distribution results for this year are presented for selected species in Figure 11 to Figure 13. These plots provide some basic insights into how catches varied by haul and by species across the study area in 2024.

Haddock data show a relatively even distribution of high catch rates across the inshore tows (shown in blue, Figure 11). While haddock were observed in every inshore tow in 2024, haddock were not observed in some shallow tows and catch rates were generally lower across shallow tows with some exceptions. Whiting data show an overall patchier spatial distribution (Figure 11) but with a higher prevalence across inshore grounds despite the highest catch rates being observed in specific shallow areas. Relatively high catch rates for cod were observed in tows to the north of Yell Sound (Figure 11). However, as with whiting, the cod results were patchy and contrast with haddock in that cod were not observed in some inshore tows despite relatively high catches in nearby grounds. Ling catches were concentrated in inshore tows mostly in the south of the study area (Figure 11).

Spatial distribution results for plaice are markedly different to those of the commercial round fish so far considered, with higher plaice catch rates consistently observed across shallow tows (Figure 12). Lemon sole data are characterised by relatively low catch rates across the survey area compared to plaice but were more evenly distributed compared to other species (Figure 12). Monkfish results were patchy and don’t reveal any obvious spatial pattern in relative abundance, while megrim catches were observed mostly in peripheral areas of the survey (Figure 12).

Squid catches were mostly concentrated in nearshore hauls and were patchy across remaining survey areas (Figure 13). Similarly, thornback ray were mostly observed in shallow areas of the survey with particularly high catches around Fetlar. Spotted ray catches were also relatively high in the Fetlar area and at the north of Yell Sound, but patchy elsewhere. Data for cuckoo ray suggest that their distribution was more widespread across inshore areas than the other commercial skate species considered here (Figure 13).

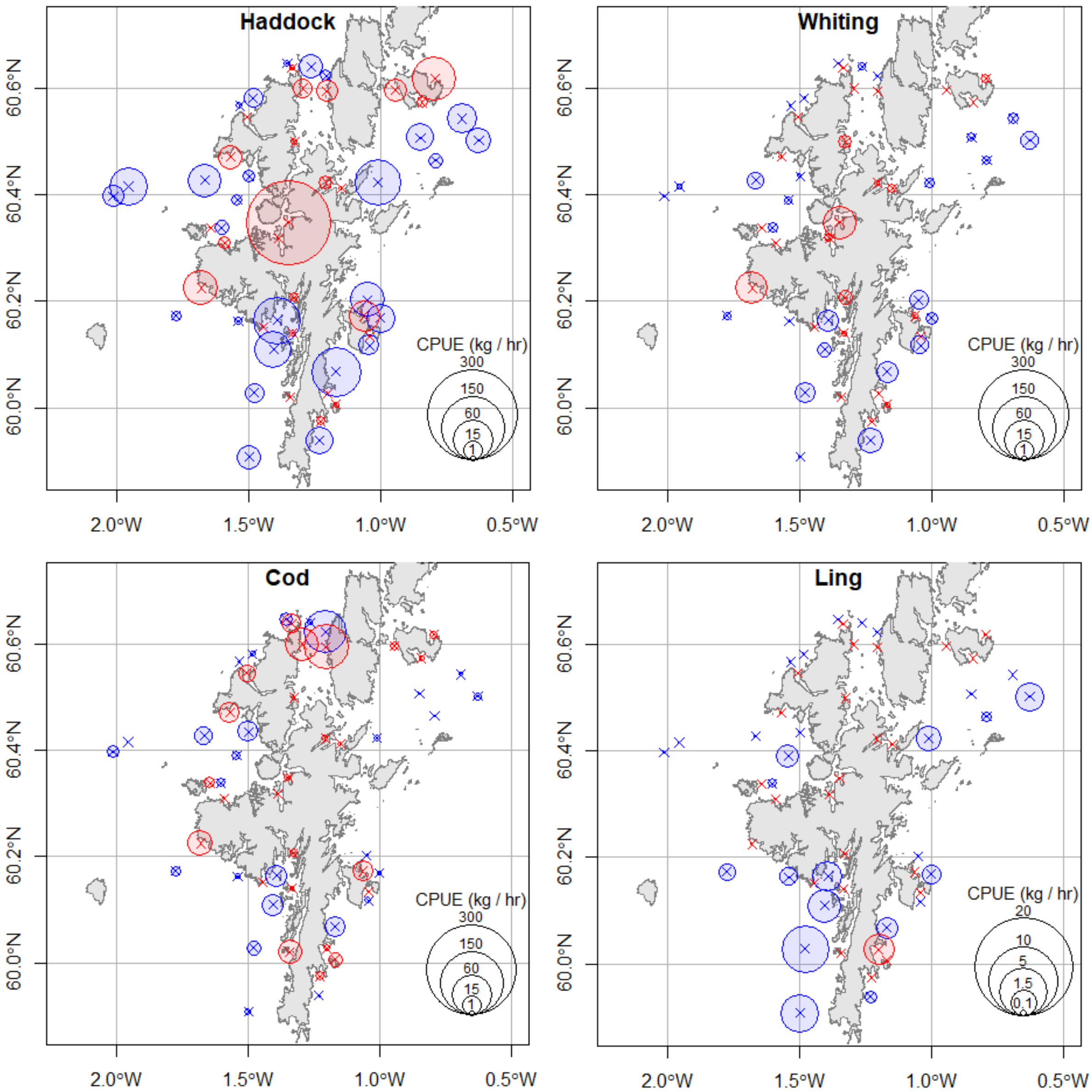

Figure 11. Spatial distribution results for selected commercial roundfish from 2024 SIFS data. For each survey haul (shown by crosses), catch per unit effort (CPUE) by weight is shown for both the inshore (blue) and shallow (red) elements of the survey. Note the different CPUE scale used for ling. **How to interpret: these results show how the catch rates by weight vary over the survey area for each species, for each haul the marker size is proportional to catch rate.**

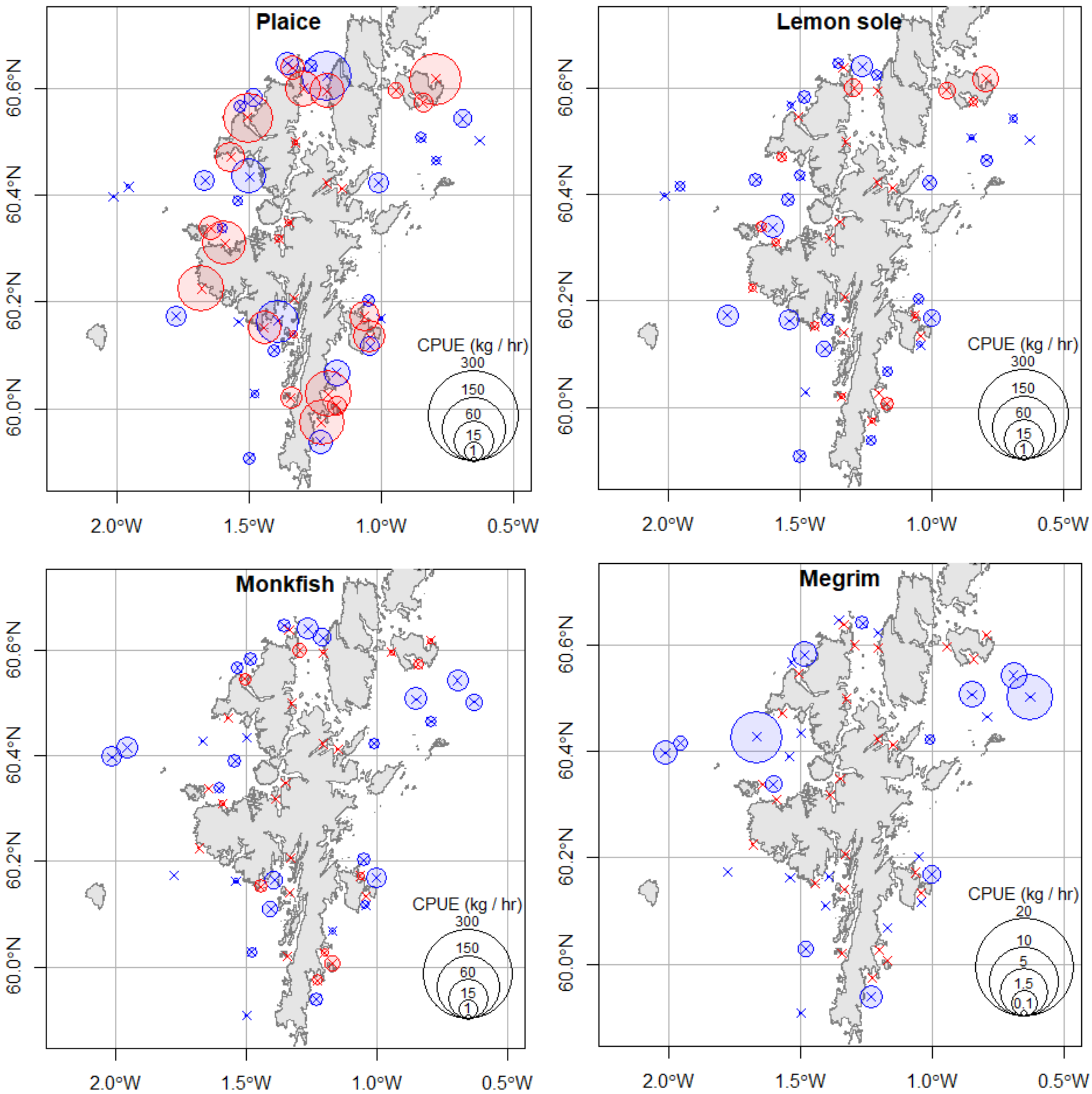

Figure 12. Spatial distribution results for other selected commercial groundfish from 2024 SIFS data. For each survey haul (shown by crosses), catch per unit effort (CPUE) by weight is shown for both the inshore (blue) and shallow (red) elements of the survey. Note the different CPUE scale used for megrim.

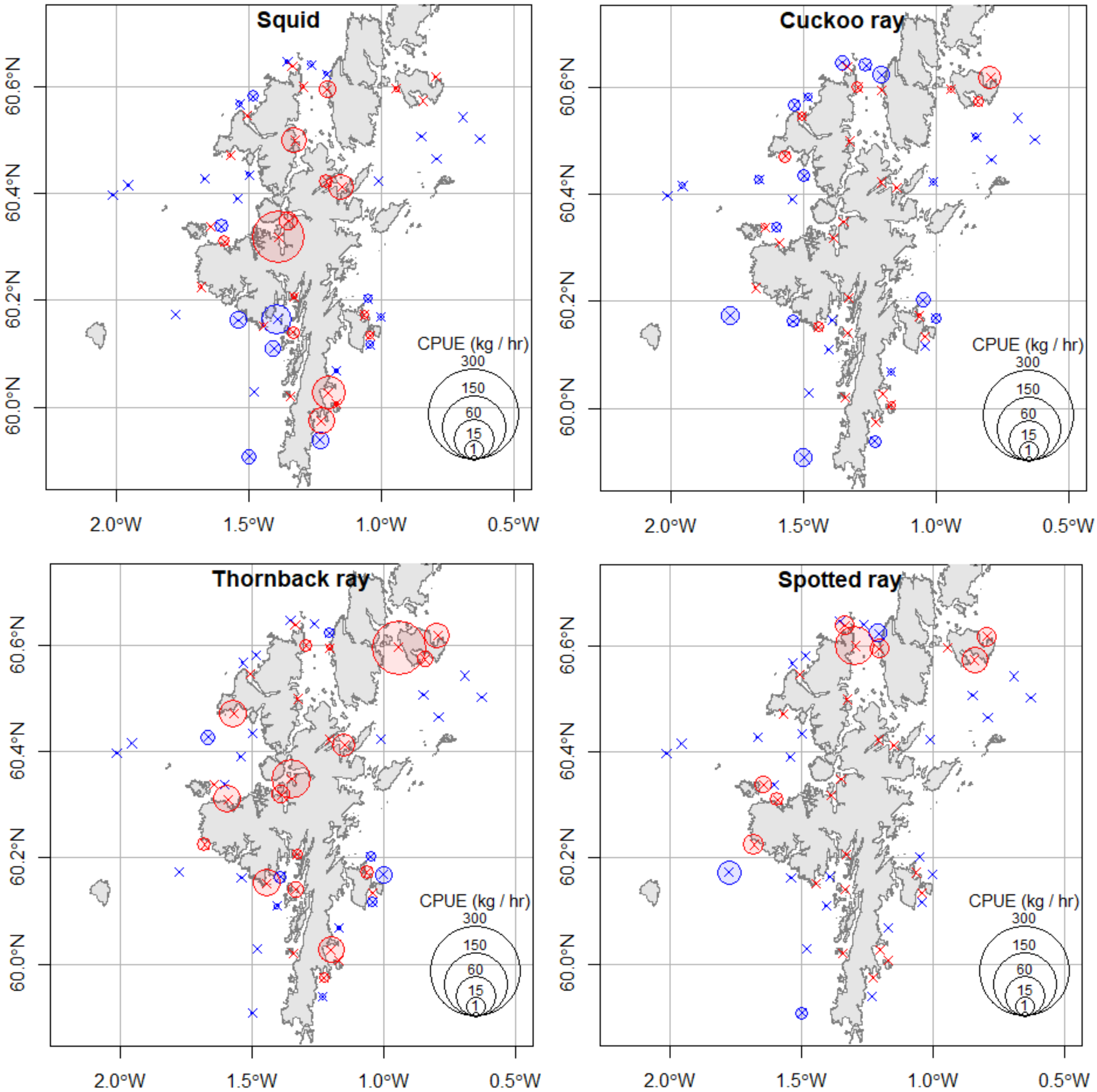

Figure 13. Spatial distribution results for squid and selected commercial skate species from 2024 SIFS data. For each survey haul (shown by crosses), catch per unit effort (CPUE) by weight is shown for both the inshore (blue) and shallow (red) elements of the survey.

4 Discussion

Variations in the catch rates and size structure of commercial fish species around Shetland have been presented which summarise the 14 continuous years of annual survey data now available. As the temporal and spatial coverage of survey data has improved, trends and patterns in the relative abundance and population structure of locally important fish species can be investigated in increasing detail. The intention of this report is to present an overview of the data. The data may subsequently be used in more detailed analyses and indeed is currently supporting a wide variety of related research projects.

The main species contributing to the overall 2024 catches continues to be haddock, with inshore haddock catches this year characterised by a clearly defined dominant peak in length data at 24 cm and another smaller separate peak centred at 35 cm. The data indicates that haddock catches in this year's survey were distributed fairly evenly across the survey area and dominated by younger age-class yet to be recruited to the fishery.

The average catch rates for most of the main commercial gadoids, i.e. haddock, cod, and whiting, were at the lower end of observed catch rates over the survey time series. However, more positively, in all cases there was more evidence of a strong age-0 year-class in 2024 than in 2023. The year-class strength, and its subsequent growth and recruitment into the fishery is known to be highly sensitive to random variations in environmental conditions and other factors. Haddock stocks in particular are well known to oscillate significantly in year-class abundances with periods of very good recruitment associated with significant increases to the overall stock. The available data here show that high catches of marketable fish follows evidence in the preceding years of the development of a strong year-class, for example in the case of haddock in 2020 - 2022 and previously in 2014 - 2016. Such results indicate the utility of a survey of this scale and provides evidence that the methods used here can detect the strength of incoming recruitment from juvenile year-classes which can be followed through subsequent years. Although the future survival rates of undersize fish are unknown, given the results from previous years it seems likely that further strong recruitment to the local commercial fishery will be observed for some gadoid species and that relatively high abundances may again be detectable in larger length classes in future surveys.

For many of the species considered here, the 2024 results were within the range of previous observations. In some other cases, notably plaice, this year's results were fairly low and might suggest a decreasing trend in recent years. In other cases, for example megrim, previously declining trends have been reversed in recent years. For some species that are currently less commercially important, the results for 2024 indicate particularly high catch rates or record prevalence across the survey area, for example spurdog, John Dory, and horse mackerel. Unusually, species that had never been observed over the previous 13 years of survey data were recorded this year in small numbers, scaldfish and imperial scaldfish, both small flatfish species typically distributed further south. Such results highlight the benefit of a survey of this type which might potentially provide an early detection of changes to fish local assemblages.

The 2024 results indicated that squid catch rate (by weight) on shallow grounds remains high following the record levels recorded last year. The high squid catches this year were again concentrated in specific nearshore areas and were more patchily distributed elsewhere in the survey. This result is particularly relevant given the current pause on the targeted inshore squid fishery, the potential impact of high squid stocks on other commercial fish species, and the ongoing discussions about a potential inshore squid fishery pilot project. Squid length data were unavailable from these surveys; however, unlike the other species considered here squid are known to have a relatively simple population structure as they are short-lived and breed only once. Consequently, squid fisheries are often characterised by substantial interannual fluctuation in landings, as annual stock size depends almost entirely on recruitment success and therefore is strongly affected by environmental conditions.

The availability of survey data from shallow waters since 2017 has provided further valuable insights into the spatial distribution and population structure of some key species. In particular, the catch rates (by number) of cod and plaice in the 2024 shallow data exceeds catch rates in the inshore data which suggests that shallow areas around the coast of Shetland may be important nursery areas for these commercially important species. Shallow areas were also shown to have greater commercially exploitable abundances of some species, for example thornback ray, and there was some spatial agreement in the tows in which relatively high catch rates for commercial skate species were observed. In contrast, the shallow data show that some species are recorded in relatively low abundances in shallow areas (for example lemon sole) or are completely absent (for example witch) which highlights the variation in habitat preferences among the selected species. Relatively high catch rates in specific hauls may be linked to the ecology of the selected species and likely related to environmental characteristics such as depth, substrate, and tidal conditions. Spatial distributions are also likely to vary with time and may have strongly defined patterns related to age-class. A research project to investigate these factors in detail is currently underway by the authors with a full report to be published early in 2025.

The overview presented here is intended to provide a short summary focussed on commercial species, and so there remains a wide range of opportunities for further analysis and interpretation of the SIFS dataset. The increasing temporal coverage of the SIFS data provides additional opportunities for comparison to data from international surveys, and efforts to utilise the SIFS data within the regional stock assessment for cod are currently progressing following positive engagement from the Marine Directorate and CEFAS. There are local priorities around ‘spatial squeeze’ within the marine environment by an increasing number of industries, and data from the survey timeseries can be utilised to provide information on areas of potential importance for juvenile fish species. A PhD project is also underway which is using the SIFS dataset to undertake a more detailed statistical analysis of spatial and temporal trends in local fish populations including non-commercial species that are likely to be important prey in the context of the overall local marine ecosystem. The annual survey provides scope for further sampling efforts, for example the collection of stomach content samples to study fish diet or the tagging of specific species to investigate movement. Recent fish survey work undertaken in Fair Isle by the authors provides further opportunities to compare SIFS results with related survey work to contextualise trends with data from the wider region.

The timely reporting of the data presented here should support the value and practicality of the SIFS to fisheries management organisations and local industry bodies. Future continuity of the annual trawl surveys around Shetland is recommended which would add value to the extensive dataset already collected and contribute to a comprehensive long-term understanding of the dynamics of local inshore demersal fish communities.

5 Acknowledgements

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